JP58-102010

(19) JAPANESE PATENT OFFICE (JP)

(11) PATENT APPLICATION KOKAI PUBLICATION NO. SHO 58[1983]-102010

(12) KOKAI TOKUHYO PATENT GAZETTE (A)

(51) Int. Cl.^{3}:
F 23 D 1/02
F 23 C 5/32

Identification Codes:

Sequence Nos. for Office Use:
6929-3K
2124-3K

(43) Publication Date: June 17, 1983

Examination Request: Filed No. of Inventions: 1

(Total of 6 pages)

(54) [Title] COMBUSTION APPARATUS

(21) Filing No.: Sho 56[1981]-198348
(22) Filing Date: December 11, 1981

(72) Inventor: Kiyomi Okada
833 Oaza-Tanai, Ube-shi

(71) Applicant: Sun Energy KK
7-22 Asahi-cho, Ube-shi

(74) Agent: Nobuyuki Fukuda, patent attorney
Takemichi Fukuda, patent attorney
Kenzo Fukuda, patent attorney

Claim

A combustion apparatus characterized in that, on one side of a tubular combustion blow-in chamber into which carbon granular fuel is blown, a similar laterally-oriented tubular combustion chamber is provided, a combustion gas discharge chamber is provided on the other side, the aforementioned fuel blow-in chamber and combustion chamber are connected through a connection opening that opens into the top part of the partition between the two chambers, while the aforementioned combustion chamber and combustion gas discharge chamber are connected through a preheating tube that passes through the aforementioned combustion blow-in chamber, and a combustion gas discharge pipe faces the aforementioned combustion gas discharge chamber.

Detailed explanation of the invention

The present invention pertains to a combustion apparatus that uses a granular, solid fuel, which is a fuel source for supplying hot water, heating, green houses, dryers and the like, and relates, in particular, to a combustion apparatus that is ideal when caking coal fuel is combusted.

There have been calls to reexamine coal and other solid fuels due to instability in the petroleum supply, but completely combusting solid fuels, or obtaining high thermal power with simple equipment is difficult. In this context, so-called fluidized bed combustion, where a solid fuel is granulized (powdered) and is combusted while stirred and floated has received attention as a combustion method to solve the aforementioned problems, but it has been difficult to accomplish combustion completely as described above with small combustion equipment having a simple structure.

The present applicant, in consideration of such background has already proposed a combustion apparatus that is a small apparatus and with which granular fuel can be combusted while stirred and floated. The combustion device is basically designed so that a vortex flow is produced in a laterally-oriented cylindrical combustion chamber, and combustion gas is directed into a combustion gas discharge chamber and is discharged to the outside through a combustion gas discharge pipe fronting said discharge chamber, and satisfactory combustion can be accomplished.

However, with this combustion apparatus, when non-caking coal fuel, such as oil coke or petroleum coke, is combusted, little foreign matter, namely, combustion by-products, adhere inside the combustion chamber, but when a caking coal fuel containing a large amount of tar is combusted, foreign matter may accumulate while adhered to the walls of the combustion chamber. This generates combustion problems, such as incomplete combustion, or makes frequent breakdown and scrubbing unavoidable.

The present invention, to solve problems such as described above, was devised concentrating on two points -- the fact that tar contained in a carbon granular fuel is gasified and changed to a non-caking fuel by preheating said fuel that is blown into a tubular combustion chamber, and the fact that the aforementioned preheating is accomplished using heat produced by combustion of said fuel. The invention is characterized in that a combustion chamber is provided on one side of a fuel blow-in chamber, and a combustion gas discharge chamber on the other side, and by directing combustion gas combusted in the combustion chamber through a heating tube passing through the aforementioned fuel blow-in chamber, the granular fuel that is blown into the fuel blow-in chamber is preheated by said heating tube.

The present invention is explained below with an application example. The combustion apparatus comprises a combustion blow-in chamber 1, a combustion chamber 2 provided on one side (the right side in Figure 1) of blow-in chamber 1, and a combustion gas discharge chamber 3 provided on the other side (left side in same). Each chamber 1, 2 and 3 is a laterally-oriented cylindrical chamber, the axis of which is horizontal, and the chambers are constructed from a tubular body 4, end walls 5 and 6, and partitions 7 and 8 made of a refractory material. A dust collecting chamber 9 is provided connected to the lower end of combustion gas discharge

chamber 3. 10 is a cooling water or cooling air circulating pipe embedded in tubular body 4 and end walls 5 and 6, 11a is the intake and 11b is the outlet thereof.

A part at the top of partition 7 between fuel blow-in chamber 1 and combustion chamber 2 is cut away and constitutes a connection opening 12 between the two chambers, and a heating tube 13 is provided at the axis of the two chambers 1 and 2. In heating pipe 13 passing through combustion gas blow-in chamber 1, an introduction opening 14 opens into combustion chamber 2, and a discharge opening 15 opens into combustion gas discharge chamber 3.

A combustion gas discharge tube 16 is inserted into combustion gas discharge chamber 3 from the outside at its axis, and a dust removal cap 17 is attached at a projecting part. Dust removal cap 17 is constructed from a ceramic or another refractory substance, and comprises an end wall 17a positioned between partition 8 and the end of discharge tube 16, and peripheral wall 17b that includes a slanted wall positioned on the outer circumference of discharge tube 16. End wall 17a and peripheral wall 17b maintain a constant distance from discharge tube 16 so as not to touch the tube, and a combustion gas flow opening 18 is provided through part of the lower end of peripheral wall 17b.

A dust collecting chamber 4 [sic; 9] connected to the lower end of combustion gas discharge chamber 3, is a large chamber positioned below said discharge chamber 3 and aforementioned blow-in chamber 1 and communicates with aforementioned combustions gas discharge chamber 3 via vertical channel 19. The diameter of a vertical channel 19 widens from front to back and left to right from discharge chamber 3 to dust collecting chamber 4 and keeps the connection surface area between discharge chamber 3 and dust collecting chamber 4 sufficiently large. A removable tray 21 is provided in the lower part of dust collecting chamber 4, and an air supply pipe 22 for accomplishing final combustion in the dust collecting chamber is inserted in the top part.

However, in aforementioned fuel blow-in chamber 1, as is clear in Figure 3, an air supply pipe 25 opens into the lower end and a fuel supply pipe 26 opens slightly above that, each being cylindrical and oriented in a tangential orientation in said blow-in chamber. Fuel supply pipe 26, as shown in Figure 5, is connected successively to a fuel mixing pipe 28 of a fuel storage hopper 27 and a blower 29. A conveying screw 31, which is driven by a drive apparatus 30 (Figure 6) is inserted into fuel mixing pipe 28, and granular (powdered) fuel in hopper 27 is directed into fuel supply pipe 26 by rotation of the screw. The amount of fuel supplied can be adjusted by changing the speed of rotation of conveying screw 31, and the amount of air can be adjusted according to the degree that a flow rate adjustment valve 32 is opened.

In combustion chamber 2 and combustion gas discharge chamber 3, air supply pipes 33, 34 and 35 open in a tangential orientation into said chambers, the same as air supply pipe 25 in combustion blow-in chamber 1. Air supply pipes 25, 33, 34 and 35 and aforementioned air

supply pipe 22 in dust collecting chamber 4 are respectively connected to aforementioned blower 29 through on-off valves 36, 37, 38, 39 and 40.

In addition, an ignition flame introduction pipe 41 opens into combustion chamber 2. The introduction pipe is connected to aforementioned blower 29 through an on-off valve 42, and an ejector 43 and a gas cylinder 45, via an on-off valve 44, are connected in the middle thereof. The ignition apparatus mixes an ignition gas and air using ejector 43, ignites them using a spark plug 46 and blows the ignition flame into combustion chamber 2 from introduction pipe 41.

Symbols 47, 48 and 49 are inspection viewing windows installed in rooms 1, 2 and 3 respectively, and 50 is a smoke sensor installed in the end part of combustion chamber 2 of heating pipe 13.

With this apparatus constructed as described above, when drive apparatus 30 for fuel storage hopper 27 and blower 29 are driven simultaneously, carbon granular fuel containing tar is blown into fuel blow-in chamber 1 from fuel supply pipe 26, and is mixed by the air flow from air supply pipe 25 to become a vortex flow. Because air supply pipe 25 opens near the discharge part of fuel supply pipe 26, mixing and floating of the granular fuel are accomplished effectively.

Granular fuel that is mixed and floating in this way enters combustion chamber 1 through upper connection opening 12 provided in partition 7, the vortex flow is reinforced by air flow from air supply pipes 33 and 34, and the fuel is ignited by the ignition gas from ignition flame introduction pipe 41. Therefore, combustion of the fluidized state begins, and the combustion gas is blown into combustion gas discharge chamber 3 through heating tube 13 from introduction opening 14. Inside combustion chamber 1, heavy fuel, which contains a large amount of preventive [sic; uncombusted] components, is positioned to the outside of said chamber by the centrifugal force of the vortex flow, and lighter gas after combustion enters heating pipe 13, so that more complete combustion can be accomplished.

When the above combustion is accomplished in a steady manner, heating tube 13 reaches a high temperature, and therefore, fuel blow-in chamber 1 also reaches a high temperature. The present invention uses this heat to preheat caking coal granular fuel that includes tar prior to combustion. That is, when the aforementioned fuel reaches a heated state, the tar included in said fuel is gasified, and the granular fuel that had been caking changes to non-caking. This change is chemically primarily analogous to carbonization of coal fuel in a fuel pre-process. The heating temperature in fuel blow-in chamber 1 varies according to the surface area of heating tube 13 and the residence time of the granular fuel, and the aforementioned carbonization may be accomplished by appropriately setting these elements. In particular, the length and thickness of heating tube 13 and the size of connection opening 12 are factors.

Therefore, steady combustion in combustion chamber 2 will be accomplished for granular fuel, the properties of which have been changed to non-caking, and the probability of

foreign matter adhering to the wall surface of said chamber 2, the wall surface of heating tube 13, etc., will be extremely low.

Then combustion gas blown into combustion gas discharge chamber 3 from discharge opening 15 of heating tube 13 converges with the air flow from air supply pipe 35, vortex combustion is continued, and finally the gas enters dust removal cap 17 through connection opening 18 provided through a part of the lower end of peripheral wall 17b of said cap, and is discharged to the outside from combustion gas discharge pipe 17 [sic; 16]. Connection opening 18 is provided through the lower end of dust removal cap 17, so the probability of combustion ash, particularly heavy preventive [sic; uncombusted] components reaching discharge pipe 16 is extremely low, and therefore, clean combustion gas can be discharged.

Also, because combustion in combustion chamber 2 and combustion gas discharge chamber 3 is performed in a vortex flow, the fuel can be kept mixed and floating for a long time. It is known that combustion in such a fluidized state can reduce generation of NOx and SOx, and therefore, can contribute to preventing air pollution. There is also the advantage that low rank coal with high ash content, high sulfur content, etc., can be used.

The combustion ash produced as a result of the aforementioned combustion drops through vertical channel 19 into dust collecting chamber 4, which has a sufficiently large volume compared to combustion gas discharge chamber 3, and is collected in tray 21. Inside dust collecting chamber 4, final combustion of uncombusted components is accomplished with fresh air from supply pipe 22, and the combustion gas rises and flows back into combustion gas discharge chamber 3.

It is known that when the combustion chamber temperature exceeds 800°C, an aqueous gasification reaction occurs as in the following reaction formulas in the presence of a small amount of water and oxygen (combustion air), combustion of fine coal (C) becomes easier, and the combustion chamber wall surfaces will not reach a temperature above the ash melting temperature.

$$H_2O + C \rightarrow CO + H_2$$
$$CO + H_2 + O_2 \rightarrow CO_2 + H_2O$$

If small quantities of water can be supplied to combustion blow-in chamber 1, the temperature of the wall surface in said chamber can be adjusted.

For this reason, with the present invention, water supply pipes 55, 56 and 57 connected to a tank 54 through on-off valves 51, 52 and 53 are open to inspection viewing windows 47, 48 and 49, and a small quantity of water can be supplied to each pipe. In particular, it is preferable that opening on-off valve 52 for water supply pipe 56 connected to combustion chamber 2 be controlled with a temperature sensor 58 facing combustion chamber 2, and that combustion

chamber 2 be prevented from reaching an abnormally high temperature. Note that trace air amount supply pipes 59, 60 and 61, each connected to blower 29, open into inspection viewing windows 47, 48 and 49, respectively, to prevent fogging of the windows.

With the combustion apparatus pertaining to the present invention as summarized above, coal granular fuel blown into a fuel blow-in chamber prior to combustion is preheated using a heating tube through which combustion gas combusted in a combustion chamber is directed into the combustion gas discharge chamber, tar included in said fuel is gasified, and said fuel can be changed to non-caking. Therefore, foreign matter is prevented from adhering to the combustion chamber inner wall, or the rate at which foreign matter is deposited and adheres is slowed, the occurrence of combustion problems is prevented, and the frequency of cleaning of the inside of the combustion chamber can be reduced. In particular, with the present invention, a special heat source is not required to combust the fuel, and it is possible to combust caking fuel that would have been difficult to use conventionally, so the utilization value is high. The cylindrical combustion chamber and combustion gas discharge chamber are also laterally oriented, so conventional oil burner boilers, dryers and the like can be used without modification.

Brief description of the figures

Figure 1 is a longitudinal cross section showing an application example of the combustion apparatus pertaining to the present invention. Figure 2, Figure 3 and Figure 4 are cross sections along line II-II, line III-III and line IV-IV, respectively, in Figure 1. Figure 5 is a system connection diagram using a sectional oblique view of a part showing the fuel and air supply piping system to the combustion apparatus. Figure 6 is a cross section along line VI-VI in Figure 5.

1 ... combustion blow-in chamber, 2 ... combustion chamber, 3 ... combustion gas discharge chamber, 7, 8 ... partition, 9 ... dust collecting chamber, 12 ... connection opening, 13 ... heating tube, 16 ... combustion gas discharge pipe, 22, 25, 33, 34, 35 ... air supply pipe, 26 ... fuel supply pipe, 27 ... fuel storage hopper, 41 ... ignition flame introduction pipe.

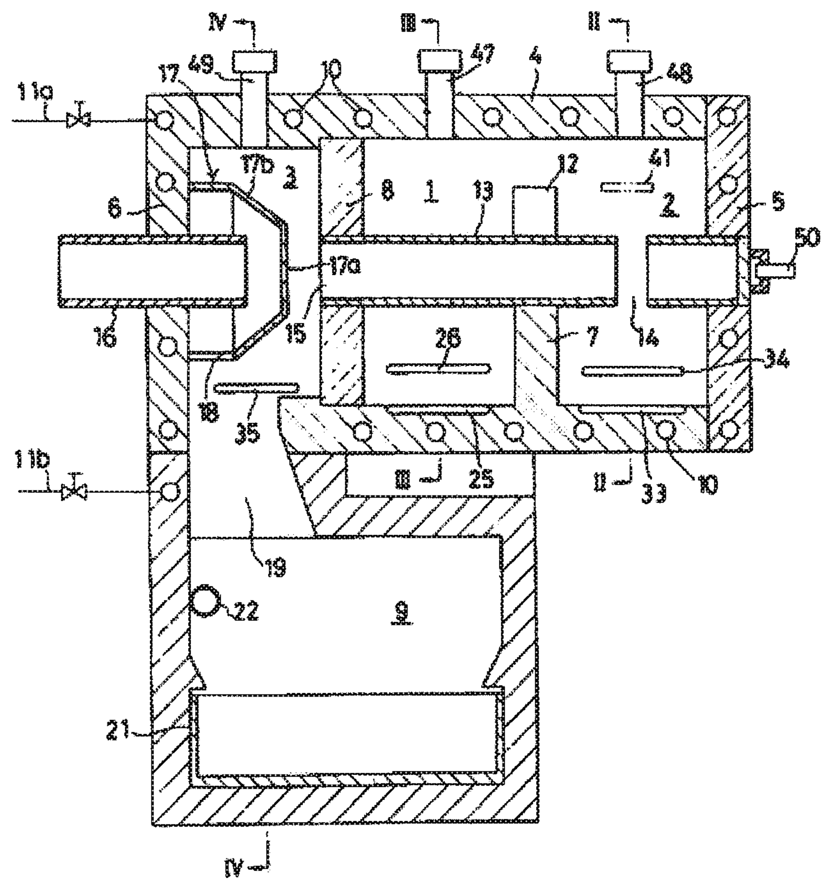

Figure 1

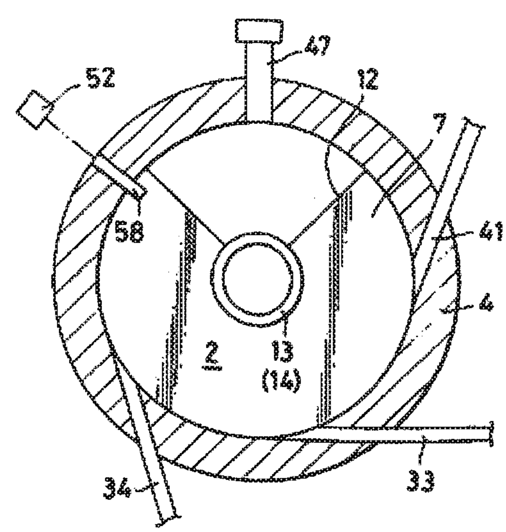

Figure 2

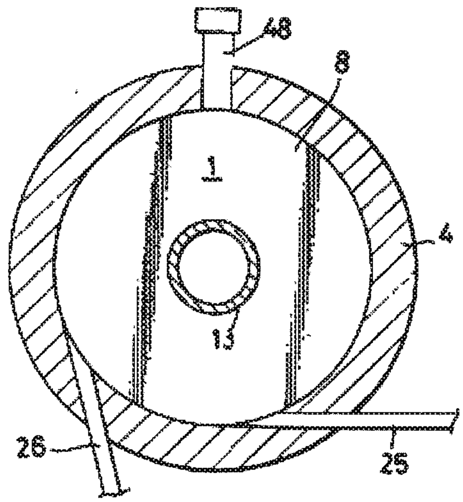

Figure 3

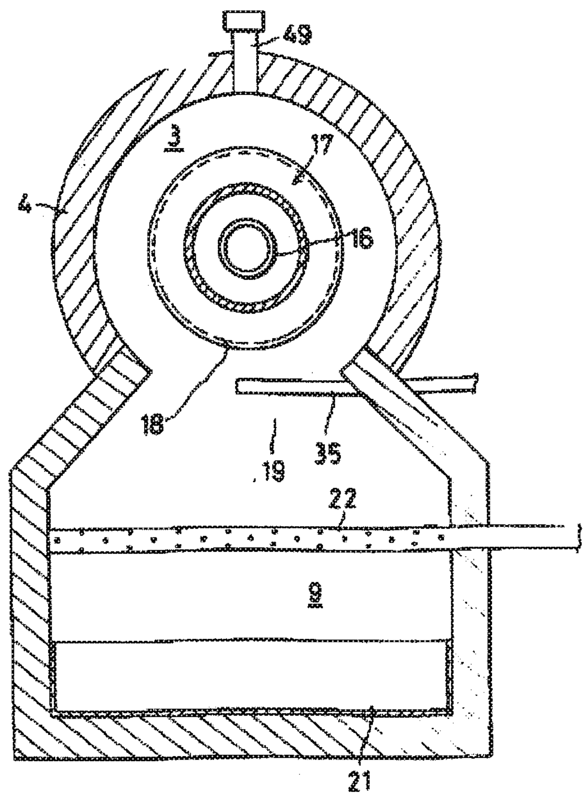

Figure 4

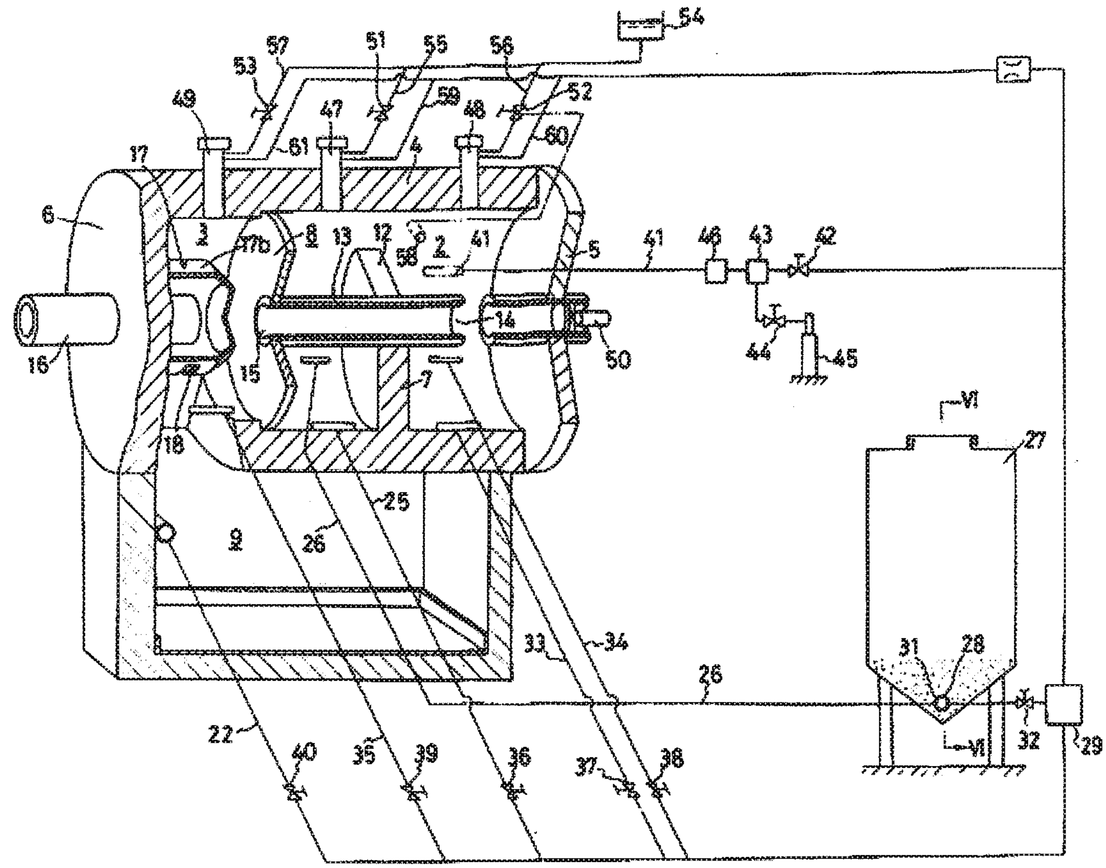

Figure 5

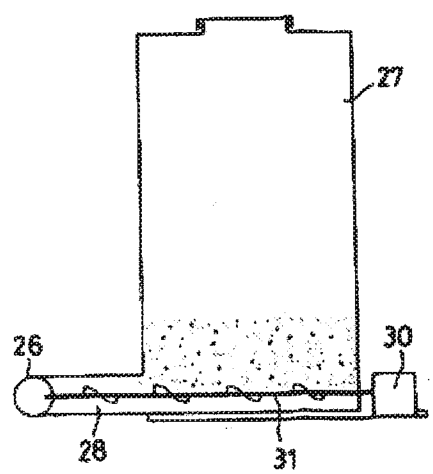

Figure 6